DOCUMENT RESUME

ED 023 576 SE 004 104

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Pre-Service and In-Service Education in Mathematics of Colorado Elementary School Teachers - A Status Report.
Colorado State Dept. of Education, Denver.
Pub Date 26 Oct 65
Note-6p.
EDRS Price MF-$0.25 HC-$0.40
Descriptors-Elementary School Mathematics, *Inservice Teacher Education, *Mathematics, *Preservice Education, Teacher Education
Identifiers-Colorado

Described are two studies related to the teaching of mathematics. A sample of 729 teachers who had received teaching certificates in 1965 and an endorsement to teach at the elementary level in Colorado schools were analyzed to determine their college preparation. The college transcripts of these teachers were examined to ascertain how many quarter hours of college credit the teachers had received in courses identified as either mathematics or mathematics education. Results of the study indicated that (1) less than four per cent of new teachers certified for the elementary level in Colorado schools had the amount of mathematics preparation recommended by the Committee on the Undergraduate Program in Mathematics, and (2) teacher preparation is not uniform in the academic subjects either among the states or among institutions within the states. A second study was undertaken to determine if there was any significant correlation between scores on a pre-test of mathematics understanding and the teachers' years of experience. The conclusion was that there was no correlation between years of experience and test scores. Therefore, the opinion that newly graduated teachers are in as much need of mathematics inservice education as experienced teachers was substantiated. (RP)

NOV 8 1966

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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PRE-SERVICE AND IN-SERVICE EDUCATION IN MATHEMATICS OF COLORADO ELEMENTARY SCHOOL TEACHERS

A STATUS REPORT

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SE004 104

THE MATHEMATICS AND MATHEMATICS EDUCATION PREPARATION OF COLORADO ELEMENTARY TEACHERS

Colorado State Department of Education
NDEA Title III Section
October 26, 1965

INTRODUCTION

The Mathematics Advisory Committee of the Colorado Department of Education identified several problems relating to the teaching of mathematics in Colorado during their first meeting in January of 1965. Most serious among these problems by the unanimous agreement of the committee was the insufficient amount of mathematics preparation for prospective elementary teachers in the colleges of the state.

In order to establish what are the facts of the situation, the committee members and several department staff members undertook certain fact finding studies which are reported herein.

I. THE PREPARATION OF NEW ELEMENTARY TEACHERS

Problem

The first of these studies was to find what mathematics and mathematics education preparation new graduates who began their teaching careers in the fall of 1965 had received in their college program.

Procedure

Type "A" teaching certificates issued during the months of May, June, July, August, and September of 1965 were given a preliminary screening to select those teachers who had received an endorsement to teach at the elementary level in Colorado schools. Those with other endorsements such as music, art, special education, or combination endorsements for elementary and secondary levels were eliminated from further consideration. Also eliminated were those teachers with prior teaching experience.

From the 4,574 receiving this initial screening, a list of 729 new teachers was obtained. The college transcripts of these teachers were then examined to ascertain how many quarter hours of college credit the teachers had received in courses which could be identified as either mathematics or mathematics education.

The sources of training were classified by state and by institution within the State of Colorado. The following table shows three averages computed for each of the classifications and for certain other groupings of interest. The first average is the raw mean obtained by simply adding the total number of quarter hours in mathematics or mathematics education and dividing by the total number of teachers in the class. The raw mean may be misleading in some instances since there are several atypical cases in the populations. A mean of three quarter hours of mathematics obtained by averaging one teacher with 42 quarter hours and thirteen teachers with zero quarter hours does not give a true picture of the "typical" teacher's preparation. In order to partially correct for this circumstance, an adjusted mean is also reported. This adjusted mean was obtained by computing the standard deviation for each class, discarding all cases which were beyond three standard deviation scores from the raw mean and

TABLE I

QUARTER HOURS OF COLLEGE PREPARATION IN MATHEMATICS AND MATHEMATICS EDUCATION OF NEW GRADUATES CERTIFIED AS ELEMENTARY TEACHERS IN COLORADO
1955

SOURCE	n	Mathematics			Mathematics Education
		Raw Mean	Refined [a] Mean	Median	Raw Mean
COLORADO	415	3.25	3.25	3.00	2.07
Colo. State College	170	3.94	3.74	3.00	2.05
University of Denver	88	1.37	1.36	1.00	1.34
University of Colorado	81	3.39	3.33	3.00	3.10
Adams State College	37	4.10	3.27	3.00	3.14
Southern Colo. State College	24	0.93	0.93	0.00	0.38
Western State	21	1.61	1.61	1.00	3.10
Colorado College	16	3.13	3.13	2.25	1.75
Loretto Heights	13	3.-	0.75	1.00	1.23
[illegible]	7	10.50	10.50	8.00	3.86
Colorado Women's College	6	1.50	1.50	1.00	0.00
Regis College	3	1.83	1.00	1.00	0.00
OUT OF STATE	304	6.23	6.11	4.50	2.56
Nebraska	42	3.50	3.38	3.00	2.91
Kansas	28	3.41	3.41	3.00	3.23
Nebraska	27	3.66	2.25	1.00	3.55
Illinois	21	7.14	7.14	7.50	2.64
Iowa	21	3.32	3.32	3.75	2.10
Texas	20	7.37	7.37	9.00	3.30
Minnesota	17	6.94	6.94	4.50	2.44
Indiana	14	8.42	8.42	6.00	3.16
Ohio	14	3.32	3.54	1.50	3.35
Missouri	13	7.47	7.47	7.50	1.30
California	8	6.75	6.75	1.50	1.50
Michigan	7	5.20	5.20	4.50	1.36
New York	7	9.86	9.80	12.00	0.86
Wisconsin	7	5.81	5.81	6.00	0.00
Pennsylvania	6	2.25	2.25	2.25	3.75
Wyoming	6	7.42	7.42	7.50	1.14
Washington	5	3.20	3.20	3.00	1.80
Arizona	4	2.25	2.25	2.25	3.38
Connecticut	4	13.50	13.50	4.50	1.13
Florida	1	1.88	1.88	4.50	1.88
New Mexico	4	5.63	5.63	6.00	2.25
South Dakota	4	1.5	1.5	1.5	2.75
Others (3 or fewer teachers)	22	5.75	5.75	4.50	2.48

Σ n = 719

(a) The refined mean was obtained by computing the standard deviation of 11 case[illegible] tions
[illegible] after the arithmetical values falling more than three standards [illegible] remaining cases
[illegible] the raw mean and then computing the mean (refined mean) [illegible]

then computing an adjusted mean for the remaining cases. The third average reported is the median number of quarter hours of preparation in mathematics. Further insight into the situation may be obtained by examination of those distributions plotted in the appendix. There were no instances of an exceptionally high number of quarter hours of mathematics education so only the raw mean is reported for this type of preparation.

Discussion of the Findings

A preliminary scanning of Table One discloses that few (3.8%) new teachers certified for the elementary level in Colorado schools have the amount of mathematics preparation recommended by CUPM and NASDTEC, namely, four courses in mathematics (15 quarter hours) and one course in mathematics education (3 quarter hours).

In discussing other findings presented in the table, most apparent is that there is a highly significant difference between the preparation in mathematics provided teachers in the state as compared to this preparation for teachers from other states. The null hypothesis tested is that there is no significant difference in mathematics preparation between teachers who have received their preparation in Colorado and those who received their preparation from states other than Colorado. This hypothesis must be rejected ($p < .001$). Had Colorado teachers received 45% more mathematics preparation, the null hypothesis would still be rejected ($p < .05$). Examining the ratio of mathematics preparation of in-state and out-of-state populations shows that the out-of-state population received 64% more mathematics. Out-of-state teachers, also, received more preparation in mathematics education.

A second observation is that teacher preparation is not uniform in these subjects either among the states or among institutions within this state. A school district personnel officer who was interested in hiring teachers with substantial mathematics preparation would be well advised to concentrate his recruitment efforts outside Colorado. If he were to further eliminate states such as South Dakota, Nebraska, Pennsylvania, Arizona, concentrating on states such as Connecticut, Oklahoma, Kansas, Illinois, Texas, Indiana, New York, and Wyoming, his chances would be improved. Such selectivity would, also, be helpful in finding teachers with some mathematics preparation within the state by concentrating attention on Southern Colorado State College, Fort Lewis, Colorado State College, Colorado College, University of Colorado, and Adams State College in preference to the University of Denver, Western State College, Loretto Heights, Colorado Woman's College, and Regis College.

A third finding is that the preparation of elementary teachers from four institutions in the state typically includes neither mathematics nor mathematics education. These institutions are the University of Denver, Loretto Heights College, Colorado Woman's College and Regis College. The small values shown generally reflect credit transferred to, rather than preparation received in, these institutions.

Finally, the sometimes heard argument that Colorado colleges cannot move in the direction of improving mathematics preparation of teachers because Colorado imports

many teachers and cannot be too far ahead of the states from which teachers are imported, is not valid. It is true that Colorado does import a large percentage of teachers (42% of this sample); however, Colorado is substantially behind the states from which these teachers are imported in regard to the amount of mathematics preparation provided new graduates. Of the twenty-three states contributing four or more newly graduated teachers to the population in this study, Colorado ranks seventeenth in order of the amount of mathematics preparation provided these new graduates.

II. THE NEED FOR INSERVICE EDUCATION IN MATHEMATICS

The mathematics consultants of the Colorado State Department of Education have been and continue to be of the opinion that there exists a pressing need for inservice education in mathematics. In an effort to solve the problem of the large numbers of teachers requiring such assistance, the Department staff developed a self-study instructional program consisting of 15 packets of material to accompany motion picture film of demonstration classes in mathematics. The course was made available in the fall of 1964 and the demand far exceeded the expectation that 3-400 teachers would be involved in the first year's program. By the end of the first year's operation 1,250 teachers were involved in the course. A voluntary pre-test, post-test evaluation of the program was conducted and approximately 700 test score pairs were obtained. The second year of operation will involve approximately 400 additional teachers.

Problem

It is the opinion of the consultants that newly graduated teachers are in as much need of mathematics inservice education as those who received their preparation ten or more years ago. In order to test this opinion with available data, a study was undertaken to see if there was any significant correlation between scores on the pre-test of mathematics understanding mentioned above and the teachers' years of experience. If new teachers were receiving better preparation in mathematics as measured by the test, then a negative correlation between the test score and years experience would obtain. The null hypothesis tested is that there is no significant correlation between pre-test scores and years of experience.

Procedure

The study utilized matched pairs of numbers, the first representing years of experience; the second, scores in the pre-test. A total of 707 of these pairs were correlated, with a coefficient of $r = -.0619$. A t-test was used to determine the significance of this result. Beginning with the hypothesis that $r = o$, and using the formula, $t = r\sqrt{\frac{N-2}{1-r^2}}$ a t value of -1.6702 was obtained. To reject the hypothesis that $r = o$, a t value of 1.96 is required at the .05 level. Hence, we cannot reject the null hypothesis.

Conclusion

We conclude that there is no correlation between years of experience and test scores. Therefore, the opinion that newly graduated teachers are in as much need of mathematics inservice education as experienced teachers is substantiated.